

STABILIZATION EVALUATION REPORT

**Bailey Disposal Site
Orange County, Texas**

**PREPARED FOR:
BAILEY SITE SETTLORS COMMITTEE**

PREPARED BY:



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(Separate Volume)

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1.0 EXECUTIVE SUMMARY

An In-Situ Stabilization Evaluation program, a requirement of the Consent Decree (CD), was conducted for the Bailey Disposal Site between August and December, 1990. The program was performed in accordance with the In-Situ Stabilization Evaluation Work Plan (ISEWP), approved by the EPA, dated August 1990, and the CD.

The three major objectives of the In-Situ Stabilization Evaluation were to: (1) further characterize the chemical and physical properties of the site; (2) define stabilization sectors and appropriate admixtures; and (3) estimate physical and hydrogeologic properties of the waste channel levee for use in design. According to the CD, the performance criteria for the stabilized waste materials is an unconfined compressive (UC) strength of 25 psi and a permeability of 10^{-6} cm/sec or one order of magnitude less than the surrounding soil. Implied in these performance requirements is a reduction of toxicity, or leachability, of the waste.

The field and laboratory portions of the evaluation indicate the Bailey Disposal Site can be characterized by nine chemically and physically similar areas. Through a three-phase admixture screening process, appropriate admixtures and quantities were selected for all nine sample areas. The final phase of the screening included a 31-day immersion test, after which the unconfined compressive strength was measured. The results of the admixture evaluation process indicated the majority of the waste

will meet the strength and permeability performance criteria with a treatment of 10 to 20 percent cement. Approximately 13 percent of the waste by volume, which had a tar-like consistency and elevated concentrations of oil and grease, could only be stabilized using lime kiln dust (LKD). The amount of LKD admixture needed to stabilize the tar-like waste ranged from 30 to 65 percent, depending on the particular waste area.

The measured permeabilities of the stabilized waste met the requirement of 10^{-6} cm/sec and in many cases were less than 10^{-7} cm/sec. Generally, the permeabilities of the stabilized waste were one order of magnitude lower than the untreated waste.

The results of the chemical analyses performed on the stabilized waste indicated an 58 percent reduction in the majority of extractable metals, and a slight decrease in semi-volatiles and volatiles.

The stabilization techniques that appear to be the most appropriate are inject and mix, and excavation/stabilization, depending on the type of waste, and the type and amount of debris present in the waste. For the two most difficult areas, where the waste has the consistency of tar, all techniques scored low. Special handling may be required for these areas.

The geotechnical data indicates the underlying soils at the site are soft to very soft. Design will take this into consideration so that performance expectations are met.

Based on the results of the unconfined compressive testing and permeability testing performed on the stabilized waste during the admixture evaluation program, the UC test should be an adequate surrogate test for evaluating both the strength of the stabilized waste and its permeability. In areas where in-situ mixing will be used, the UC test may not be as good a surrogate test depending on the resulting void ratio after mixing.

Finally, trenching proved to be a good method for determining the waste/soil interface, particularly in the Area East of Pond A. In areas with large amounts of municipal debris and a high groundwater level, trenching was difficult and less beneficial. The Cone Penetration Test (CPT), although useful in determining differences in the physical properties of the waste and underlying natural soils, was not as accurate as hoped in determining the waste/soil interface. The primary reason for this is that the shear strength (penetration resistance) of the waste and underlying natural soils were too similar to differentiate one from the other. However, after stabilization, the strength difference will be pronounced and the CPT should be an excellent method for evaluating the depth of stabilization.

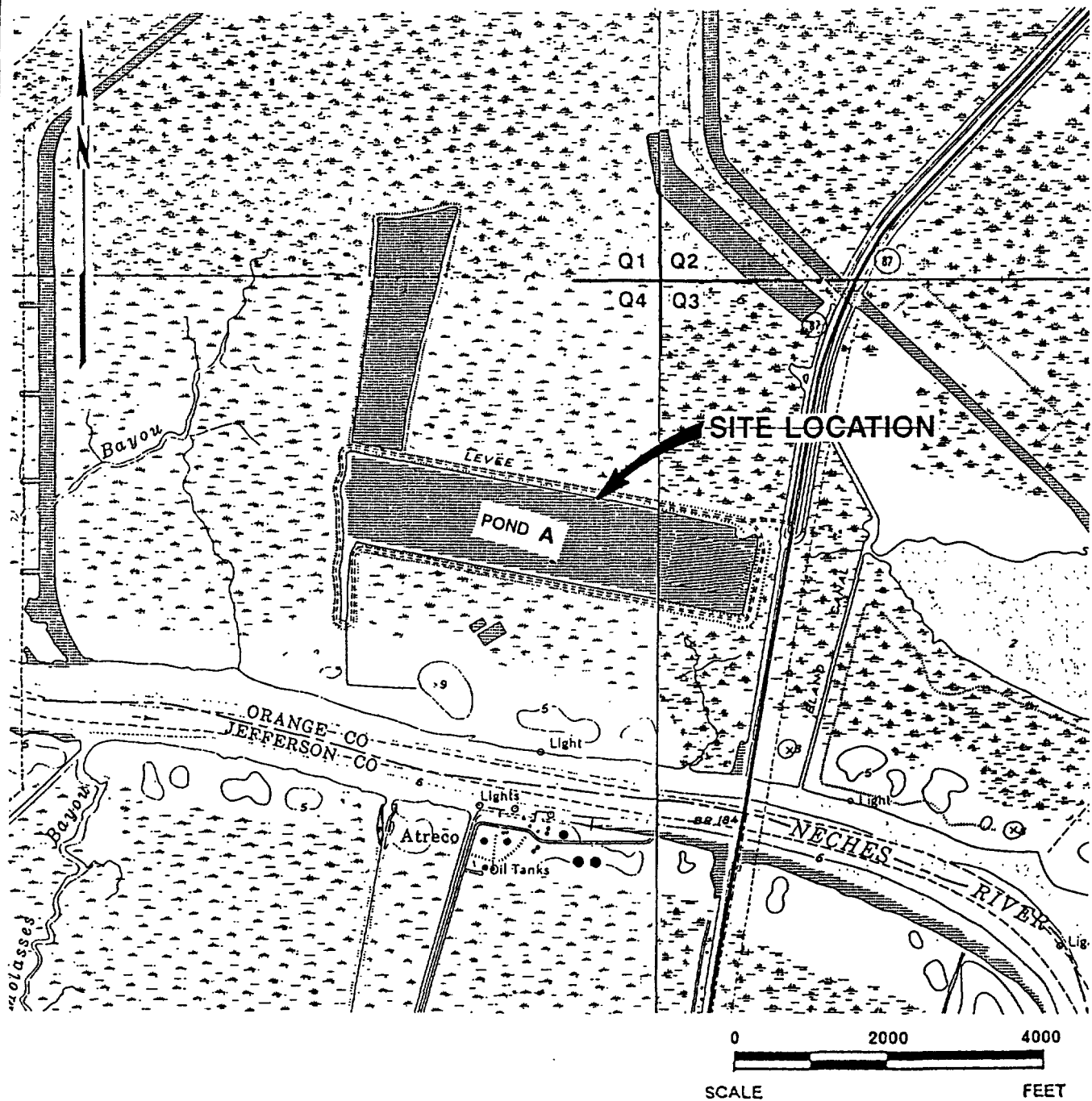
2.0 INTRODUCTION

2.1 Site History/Background

A Vicinity Map and General Site Map are presented in Figures 1 and 2 for the Bailey Disposal Site. As addressed in the 1988 Final Draft Feasibility Study Report, the approximately 280-acre site was operated by Mr. Joe Bailey pursuant to his ownership and leasehold interests from the early 1950's through March or April 1971. The site is bounded by undeveloped marsh lands and agricultural tracts and is approximately 2 miles from the nearest residential area.

Mr. Bailey utilized the site in part as a disposal facility for industrial, municipal, and other wastes during this period. Wastes were accepted for disposal for a fee and placed in excavated pits. In addition to industrial wastes, the site received municipal waste, garbage, and trash from various cities and towns in the area. The site was also open to the public for the disposal of waste. Household trash, construction debris, and miscellaneous trash continued to be deposited at the site after Mr. Bailey died in 1971. Shortly after Mr. Bailey's death the site was closed by his family. The waste disposal areas identified during the RI/FS are listed below:

Waste Channel Area - Approximately 2000 feet long and 170 feet wide, varies from 2 to 14 feet deep, and is located north of Pond A, between Pond A and the northern levee. Waste materials consist of both industrial and municipal waste.



REFERENCES: Q1 - TERRY TEXAS U.S.G.S. QUADRANGLE MAP, PHOTOREVISED 1970 AND 1974 (MODIFIED)
 Q2 - ORANGEFIELD, TEXAS - LOUISIANA U.S.G.S. QUADRANGLE MAP, PHOTOREVISED 1970 AND 1974, (MODIFIED)
 Q3 - WEST OF GREENS BAYOU, TEXAS - LOUISIANA U.S.G.S. QUADRANGLE MAP, PHOTOREVISED 1970 & 1974, (MODIFIED).
 Q4 - PORT ARTHUR NORTH, TEXAS U.S.G.S. QUADRANGLE MAP, PHOTOREVISED 1970 & 1974, (MODIFIED).

FIGURE

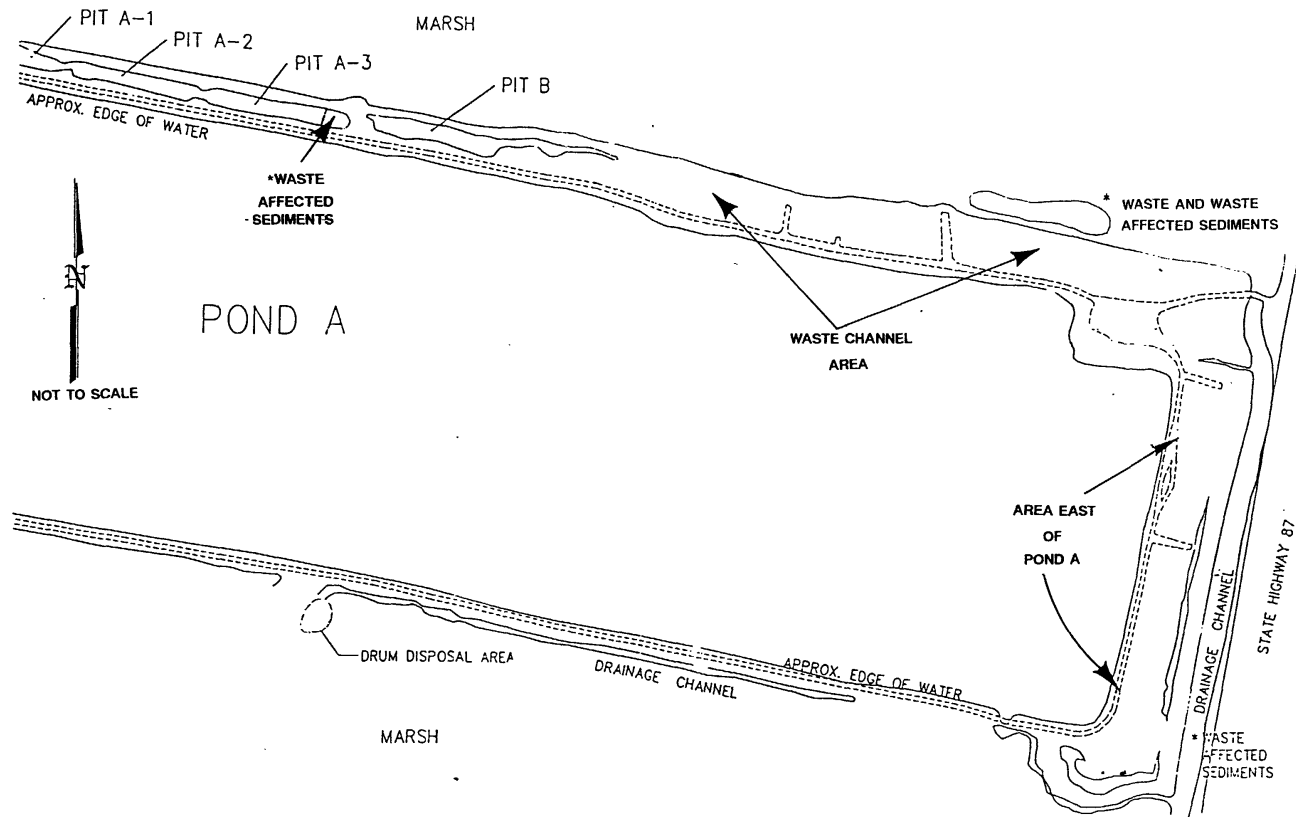


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VICINITY MAP
 BAILEY DISPOSAL SITE
 ORANGE COUNTY, TEXAS

1

DRAWN <i>[Signature]</i>	JOB NUMBER 19559,027.12	APPROVED <i>[Signature]</i>	DATE 12/21/90	REVISED <i>[Signature]</i>	DATE 2/25/91
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* GENERAL LOCATION, EXACT LOCATION AND DEPTH NOT WELL DEFINED.



Harding Lawson Associates
Engineers, Geologists
& Geophysicists

General Site Map
Bailey Disposal Site
Orange County, Texas

Figure
2

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	19559,027.12	<i>RLW</i>	12/22	<i>YAW</i>	2/25/91

Area East of Pond A - Located on the east side of Pond A, this area is approximately 1500 feet long, 225 feet wide and varies between 0.5 and 10.5 feet deep. The waste material consists primarily of industrial waste.

Pit B and Pit A-3 - Located on the north side of Pond A and west of and adjacent to the Waste Channel Area, Pit B is approximately 775 feet long, 40 feet wide, and from 2 to 9.5 feet deep. Pit A-3, located west of Pit B is approximately 440 feet long and 40 feet wide. The RI/FS indicates that Pit B and the eastern 150 feet of Pit A-3 primarily contain tar-like, industrial waste materials. Both pits contain standing water.

Drum Disposal Area - Indicated in the RI/FS to be a circular area approximately 78 feet in diameter, located on the south side of Pond A, approximately 2400 feet west of the pond's southeast corner. Waste materials in this area consist primarily of a powdery carbon-like substance.

2.2 Current Site Status

The site remains closed and vehicular access to the site is controlled by a locked gate across the wooden bridge leading to Highway 87. The site has been fenced along the north and east sides. Some of the current property owners retain keys to the gate which allows them access to the site.

Sixteen monitoring wells installed during previous investigations remain on the site, and 14 piezometers remain in the Waste Channel Area and in the Area East of Pond A. Previous investigations at the Bailey Disposal Site identified thirty-one organic Target Compound List Chemicals (TCLC) in the waste materials. In addition to organic compounds, heavy metals were present in the waste material. The TCLC in the waste were grouped into six categories: Volatile Organic Compounds, Semi-volatile

Organic Compounds, Heavy Metals, Volatile Chlorinated-Hydrocarbons, Polynuclear Aromatic Hydrocarbons, and Phenol and Phenolic Compounds.

The TCLC that were reported throughout the Waste Channel Area include benzene, toluene, styrene, xylene, ethylbenzene, arsenic, and chromium. Generally, the concentration of volatile organics decreased with depth in the waste material while semi-volatiles and metals appeared to be more evenly distributed vertically and horizontally throughout the waste.

Fewer organic compounds were detected in the Area East of Pond A compared to the Waste Channel Area. However, the concentrations of those organic compounds detected in the Area East of Pond A are higher than concentrations observed in the Waste Channel Area. Metals concentrations in the Area East of Pond A are comparable to concentrations in the Waste Channel Area.

The RI analysis of sediment samples from the west end of Pit B indicated the highest contaminant concentrations. Both volatile and semi-volatile organic compounds were detected along with several metals. The analysis of sediment samples from the east end of Pit A-3 (located adjacent to Pit B) indicated lower metals concentrations, and lower unknown and tentatively identified semi-volatile organic compounds. No volatile organic compounds were detected in sediment samples from Pit A-3.

2.3 Previous Stabilization Treatability Study

A stabilization treatability study was performed as a part of the FS. Two composite waste samples were obtained, one from the Area East of Pond A and one from the Waste Channel Area. For each of these areas, both a 20-percent cement and a 50-percent fly ash admixture were evaluated. Chemical analyses and physical testing were performed prior to and after the addition of the stabilizing agents. The results of the chemical analyses of the stabilized waste indicated a 71 to 100 percent reduction of leachable TCLP constituents. Cement stabilized samples generally indicated a decrease in extractable metals. The fly ash treated samples indicated higher extractable metal concentrations than the untreated wastes.

The results of the physical testing indicated that the permeabilities of the stabilized wastes were as much as ten times lower than the untreated waste. The unconfined compressive strength for untreated waste samples were 4.2 and 11.3 psi. Test results for samples treated with 50-percent fly ash indicated unconfined compressive strengths ranging from approximately 18.8 to 37.5 psi. Test results for samples treated with 20-percent cement had measured unconfined compressive strengths ranging from approximately 30.6 to 37.5 psi.

2.4 Work Plan For In-Situ Stabilization Evaluation

As required by the Consent Decree, a work plan was developed by the Bailey Site Settlers Committee for performing the In-Situ Stabilization Evaluation. The objective of this work was to supplement existing data generated during the RI/FS for use in the design of the remedial measures. Additionally, a Quality Assurance Project Plan (QAPP) was developed for the In-Situ Stabilization Evaluation. These documents, titled "Work Plan For In-Situ Stabilization Evaluation", August 1990, and "Quality Assurance/Quality Control Plan for In-Situ Stabilization Evaluation", August 1990 were reviewed and approved by the EPA. The work reported herein was performed following the work plan and QAPP.

3.0 FIELD INVESTIGATION AND FINDINGS

The field investigation was conducted between August 13 and August 31, 1990. The scope of the field investigation included:

- Drilling and sampling 11 geotechnical borings adjacent to the waste areas to investigate the engineering properties of surrounding soils for design purposes.
- Drilling and sampling 18 borings in the waste areas designated in the RI/FS.
- Excavating 15 trenches with a backhoe to augment or supplement waste samples obtained from the borings.
- Compositing samples from waste borings and trenches for the subsequent laboratory admixture stabilization evaluation.
- Performing 15 cone penetration tests (CPT) in the waste areas to evaluate the effectiveness of the cone as a tool to delineate waste boundaries during remediation. Additionally, the cone penetrometer was used to collect geotechnical data necessary for design.
- Performing a field audit to see that the procedures outlined in the Work Plan and QAPP were being followed, and to identify any required modifications to these procedures.

3.1 Geotechnical Borings

Eleven geotechnical borings designated HLA-21 through -32, were drilled at the locations shown on Drawing 1 in the Illustrations and logged by a Harding Lawson Associates' (HLA) geologist. HLA-21, -26 and -31 were drilled to a depth of 29 to 32 feet. These deeper borings were conducted due to softer soils being encountered than anticipated. The other borings were terminated at a depth of 15 feet, as planned. Bulk and undisturbed

samples were obtained for visual classification and geotechnical laboratory testing.

The borings were advanced using a CME-55, track-mounted drill rig and hollow-stem augers. Undisturbed soil samples were taken in 2 to 5 foot intervals using thin-walled (Shelby Tube) and standard split-spoon samplers. Upon completion, all of the deep (30-foot) borings were grouted with a bentonite slurry using a tremie pipe, as requested by EPA in the field.

The Standard Penetration Test was used in the field to determine the relative density of granular soils encountered. Pocket Penetrometer readings were taken to estimate the unconfined compressive strength of cohesive soils. A Photoionization Detector (PID), with 10.2 eV probe was used to screen samples for volatile organic vapors. The results of these field tests are presented and the soil types and conditions encountered were logged and described on the Logs of Borings in Appendix A. The soils were classified in accordance with ASTM Test Methods D2487-85, the Unified Soil Classification System, also shown in Appendix A.

The soil samples obtained from the geotechnical borings were transported to Harding Lawson Associates' Houston laboratory where they were examined to confirm their field classification and to select samples for geotechnical testing. The geotechnical testing included:

- 8, Moisture Content (ASTM Test Method D2216);
- 8, Bulk Density (ASTM Test Method D2937);

- 6, Atterberg Limits (ASTM Test Method D4318);
- 8, Compressive Strength (ASTM Test Method D2166);
- 1, Particle Size Analyses (ASTM Test Method D422);
- 4, Consolidation Tests (ASTM Test Method 2435); and
- 6, Minus 200 Sieve Analyses (ASTM Test Method D1140).

The results of the sieve analyses and consolidation tests are presented in Appendix B. The remaining test results are presented on the Logs of Borings in Appendix A.

The natural soils encountered at the site are generally silts, clays and clayey silts of medium plasticity. These soils were generally soft to very soft. Consolidation tests performed on near surface (0-5 feet) soil samples indicated slightly to highly overconsolidated conditions due to compaction and/or desiccation. At a depth of 10 to 15 feet, the soils were generally underconsolidated. At depths of 29 to 30 feet, the soils exhibit higher shear strength and lower compressibility.

Groundwater level observations made in the open boreholes during and after completion of drilling generally indicated water levels between 3 and 11 feet below ground surface. Industrial waste was observed in two of the geotechnical borings, HLA-24 and -25.

3.2 Waste Borings

Eighteen waste borings designated HLA-1 through -5 and HLA-7 through -19, were drilled at locations shown on Drawing 1 in the

Illustrations. The borings were sampled continuously and logged by an HLA geologist. Most of the borings ranged in depth from 5 to 12 feet. Borings HLA-1 through -3 were drilled in Pit A-3 and Pit B from a small barge using a hand-auger. Boring HLA-4 was also drilled in Pit B, from along side the Pit using a hand-auger. A standard split-spoon sampler was used to obtain samples for lithologic description. A bucket sampler was also used to obtain sufficient volume of sample necessary for the admixture stabilization evaluation. The remaining waste borings were drilled using a track-mounted, CME-55 drill rig and hollow stem augers. Shelby Tube, Sprague and Henwood (S&H) split-barrel and bucket type samplers were used to obtain samples for logging purposes. Auger cuttings were also collected to provide sufficient volume of sample necessary for the admixture stabilization evaluation.

Each sample obtained for profile purposes was removed from its respective sampler, and screened for volatile organic vapors with a PID, using a 10.2 eV probe and then visually classified. This information was entered onto the field logs and is shown on the Log of Boring forms presented in Appendix A. At each boring location, samples collected for logging purposes, along with other bulk samples obtained from auger cuttings and bucket samplers, were placed in new, 5-gallon plastic buckets with fitted lids. The buckets were labeled to reference the individual boring from which the sample was obtained, taken to the general staging area and placed on ice, in a covered, lined trench. The samples remained in

the trench until compositing. Compositing was conducted on Wednesdays and Fridays, or when sufficient knowledge of adjacent borings were obtained, and sufficient time was available for chemical analysis to be conducted within the holding times.

The waste borings indicated an industrial waste thickness as thin as 0.8 feet at HLA-3 in Pit B and as thick as 10.5 feet at HLA-8 north of Pond A. The average depth of waste along the East Side of Pond A was 5.0 feet. An isopach map showing waste thickness across the site is presented on Drawings 2A and 2B in the Illustrations. This map was developed using the aerial survey data from the RI and from field data collected during the RI and the work described here. Waste volumes were calculated using the isopach map and are further discussed in Section 4.3. These volumes are expected to change somewhat when the ground survey that is being performed for design is completed.

Groundwater was generally encountered during drilling at an average depth of 3.6 feet below the ground surface in the waste borings. Groundwater level measurements made after allowing the borehole to remain open for 24 hours generally indicated near identical or slightly lower groundwater levels.

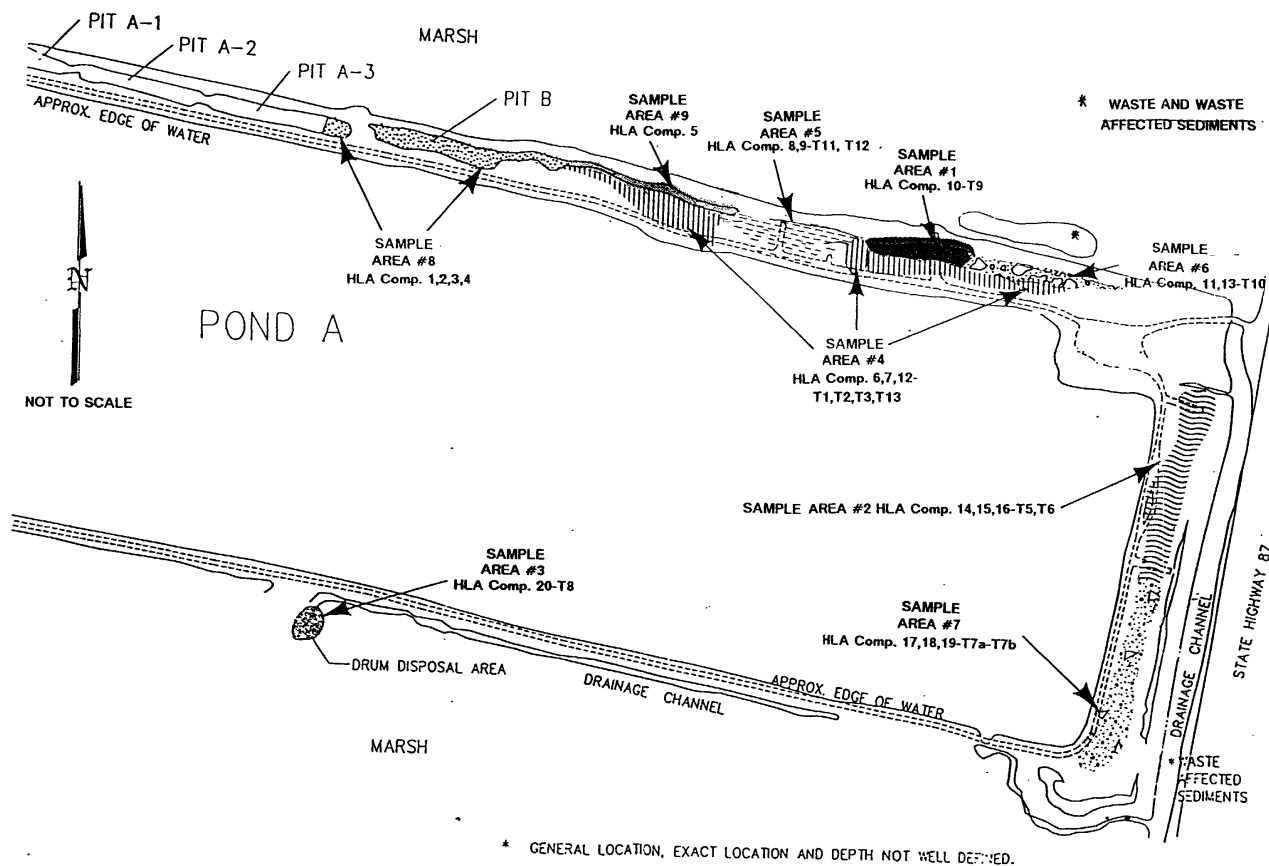
The samples from the waste borings provided for gross physical characterization and volatile organic vapor screening of the waste at each boring location. This information was used for sample compositing. The map in Figure 3 presents the resulting

nine composite sample areas. Table 1 presents a general waste description by area and the samples composited within each area.

3.3 Trenching

Fifteen trenches designated T-1 through -13, HLA-6 and HLA-20 were excavated at the locations shown on Drawing 1 in the Illustrations. Originally only eight trench excavations were planned. The use of trenching was expanded due to its success in areas of shallow waste (generally less than 10 feet) and little or no groundwater infiltration. Trenches were supplemented for proposed borings HLA-6 and HLA-20. Locations T-9 through -13 were added to provide additional sample volume for the admixture stabilization evaluation at specific boring locations.

Trenches T-1 through -8, HLA-6 and HLA-20 were carefully excavated to provide waste profile descriptions, PID and pocket penetrometer readings. They were excavated their entire length, one to two feet at a time. Samples were collected along the length of the trench, logged, and representative samples were placed in new, 5-gallon buckets with fitted lids. The sample containers were labeled and placed in the trench at the general staging area with ice where they were stored until compositing. Trenches T-9 through -13 were excavated adjacent to waste borings to obtain additional sample volume at these locations. Waste profile logs were kept for each trench. If significant differences were observed between the trench and the adjacent boring (e.g., T-10 and HLA-12), the trench



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COMPOSITE SAMPLE LOCATIONS

Valley Disposal Site
Orange County, Texas

Figure
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TABLE 1
WASTE DESCRIPTION BY AREA

<p>Sample Area 1</p> <p>HLA Comp. 10-T9</p> <p>Black Cindery Waste</p> <ul style="list-style-type: none"> - dry, soft - high PID readings up to 500 ppm - boulder size rubbery chunks, oily at depth, no municipal waste noted. 	<p>Sample Area 6</p> <p>HLA Comp. 11,13-T10</p> <p>Black Cindery and Rubbery Waste</p> <ul style="list-style-type: none"> - moist, soft - with some tar-like waste, no municipal waste noted
<p>Sample Area 2</p> <p>HLA Comp. 14,15,16,-T5,T6</p> <p>Black Cindery Waste</p> <ul style="list-style-type: none"> - dry, soft - some municipal waste - soft, with gravel size rubbery waste 	<p>Sample Area 7</p> <p>HLA Comp. 17,18,19-T7a,T7b</p> <p>Black Cindery Waste</p> <ul style="list-style-type: none"> - saturated, soft - some rubbery chunks, no municipal waste noted
<p>Sample Area 3 (Drum Disposal Area)</p> <p>HLA comp. 20-T8</p> <p>Black Cindery Waste</p> <ul style="list-style-type: none"> - dry, soft - excavation and placement may require separate treatment 	<p>Sample Area 8 (Pit A-3, B)</p> <p>HLA Comp. 1,2,3,4</p> <p>Black Oily Tar-like Waste</p> <ul style="list-style-type: none"> - saturated, very soft - with silt
<p>Sample Area 4</p> <p>HLA Comp. 6,7,12,-T1,T2,T3,T13</p> <p>Industrial and Municipal Waste</p> <ul style="list-style-type: none"> - saturated, very loose to hard, cemented blocks discovered - excavation likely required during remedial action - Black cindery and rubbery wastes with boards, trees, tires and appliances 	<p>Sample Area 9</p> <p>HLA Comp. 5</p> <p>Black Tar-like Waste</p> <ul style="list-style-type: none"> - moist, very soft, - very sticky with trace municipal waste
<p>Sample Area 5</p> <p>HLA Comp. 8,9-T11,T12</p> <p>Black Rubbery Waste</p> <ul style="list-style-type: none"> - saturated, soft - with tar-like and cindery layers - large amounts of municipal waste 	

was lengthened and a more detailed log was written. However, T-9 through 13 were generally shorter and the adjacent boring log more detailed. Appendix A presents the trench logs. If significant horizontal changes occurred over the length of the trench, a trench profile for the entire length of trench was developed and is also presented in Appendix A.

Trenches were useful in Sample Areas 1 through 3, 6 and 7. Trenching allowed for waste profile descriptions and the determination of the waste/soil interface at these locations. Large amounts of municipal waste and groundwater infiltration in Sample Areas 4 and 5 made excavation difficult. Obtaining representative samples for waste profile descriptions and determining the waste/soil interface using trenches was difficult to impossible in these areas. However, borings accurately defined the waste/soil interface and are recommended for waste/soil interface determination during remediation in Sample Areas 4 and 5.

3.4 Waste Compositing and Sampling

Waste samples collected from adjacent borings and trenches that exhibited similar physical and chemical characteristics were composited in the field. The results of chemical analyses from the RI were used in evaluating chemical characteristics. At the general staging area, a 2-foot deep, 10-foot long lined trench was maintained for storing the 5-gallon sample containers prior to further compositing and transportation to the laboratories. The 5-

gallon buckets were iced and the trench was covered with 3/4-inch plywood to maintain the samples in a cool condition simulating subsurface conditions. This sample storage method was reviewed with the EPA Project Manager and approved. Initial compositing was performed in a No. 1 wash tub, covered with polyethylene sheeting to limit the loss of volatiles, and hand mixed. This method proved inefficient from a time and resource point of view, and an alternate method was discussed with EPA and approved as described below. Except for the initial Sample Area 7 composite sample, each of the other samples was composited in a new or properly decontaminated 30-gallon, galvanized metal trash can, using the drill rig auger for mixing. After samples were homogenized, composited samples were placed in new, 5-gallon buckets with fitted lids and labeled. Prior to sealing the buckets, a sample was taken for chemical analysis to characterize the samples. The sampling, packaging and shipping protocols used for analytical samples followed those described in the Work Plan and QAPP. The chain-of-custody forms for the delivery of analytical samples to Keystone Environmental Resources, Inc. (Keystone) and sample results are presented in Appendix B. HLA delivered the bulk samples to its laboratory in Houston where the admixture stabilization evaluation was performed.

After reviewing the results of the initial chemical and physical properties testing, it was concluded that the samples were sufficiently composited between the sampling areas and further

compositing to reduce the number of samples for admixture evaluation would be of no benefit.

3.5 Cone Penetration Testing

Fifteen cone penetration tests (CPT) designated CPT-1 through -12 and CPT-14 through -16 were performed at the locations shown on Drawing 1 in the Illustrations. The CPT-13 location was inaccessible due to soft ground. CPTs at locations CPT-3 through -11 and CPT-14 through -16 were performed to evaluate the effectiveness of this method to delineate waste/soil interface. CPTs at locations CPT-1, -2 and -12 were performed to collect geotechnical data for use in remedial design.

The CPTs were conducted by Terra Technologies in accordance with ASTM Test Method D3341 specifications, under HLA's supervision. A report prepared by Terra Technologies which summarizes the CPT work is presented as Appendix C. A truck-mounted CPT unit utilizing a 3-channel cone was used. Soil behavior is interpreted by the 3-channel cone which produces strip-chart sounding plots for tip resistance, sleeve resistance and friction ratio values. The numerical data derived from the soundings are interpreted by computer to provide lithologic descriptions, and geotechnical parameters based on the soil behavior interpretations.

Using empirical correlations, strength is a parameter derived from the CPT. Since one of the performance criteria for

stabilization at the Bailey Disposal site is attaining a minimum unconfined compressive strength of 25 psi, the CPT could be used to assess this criteria in-situ. However, the empirical correlations used for obtaining unconfined compressive strength may not be totally accurate with regard to local soil conditions and/or the stabilized waste. Therefore, core soil samples should be obtained and unconfined compressive strength tests performed to provide ground truth, verify and/or draw correlations between CPT results and the unconfined test results. The use of the CPT and borings for ground truth during post stabilization evaluations is discussed further in Sections 6.2 and 6.3.

CPT lithologic and engineering properties interpretations of natural soils below the waste and at the geotechnical locations were consistent with those from the borings. Both indicated soft to very soft, fine grained silty clays and clayey silts. Although the CPT was useful in determining gross differences in the geotechnical properties of the waste and underlying soils, it could not accurately determine the waste/soil interface. At locations where CPTs were conducted side-by-side with borings, the elevation of the waste/soil interface interpreted from the CPT was generally about one to five feet different than visually logged at the nearby boring. The reason for this is that there is not sufficient strength (penetration) difference between the waste and natural soils.

3.6 Pit Water

Water from Pit A-3 and Pit B was collected and analyzed to determine whether pumping from one pit to the other during remedial activities can be done without cross contamination and to preliminarily evaluate disposal requirements. TCLP metals, Total Petroleum Hydrocarbons, and all Hazardous Substance List (HSL) listed volatile organic compounds were performed. Tables 2 and 3 presents the results of these analyses for inorganic and organic compounds, respectively. The results of the laboratory analyses indicate that the sample from Pit B contained a slightly higher concentration of some metals (Arsenic, Barium, Copper, and Zinc) and carbon disulfide, than the sample from Pit A-3. Neither sample indicated TPH concentrations above the method detection limit. Based on these results, transport of water from Pit B to Pit A-3 would be feasible during the remedial action. Sampling of the pit water may be necessary at the time of removal if mixing with the contaminated sediments in the pits occurs and the water will be disposed of off site.

3.7 Field Audit, QA/QC

A field audit was conducted on August 24, 1990 by Steven R. Neely, P.E., Project Manager for Harding Lawson Associates. The field supervisors' field notebook, procedures, and field boring and trenching logs were checked and determined to be up-to-date and accurate. Site security and safety procedures were checked and

TABLE 2
SUMMARY OF DETECTED INORGANIC COMPOUNDS
PIT WATER
BAILEY DISPOSAL SITE

PARAMETER	PIT A-3 (ppm)	Pit B (ppm)
TCLP METALS ⁽¹⁾		
ARSENIC ⁽²⁾	0.003/0.003 ⁽³⁾⁽⁴⁾	0.004/0.003
BARIUM ⁽⁵⁾	0.170/0.018	0.350/0.018
COPPER ⁽⁵⁾	BDL/0.005 ⁽⁶⁾	0.016/0.005
ZINC ⁽⁵⁾	0.015/0.005	0.033/0.005

NOTES: (1) TCLP Extraction was performed if the percent solids were greater than 0.5%.
 (2) EPA 7060
 (3) Results of analysis converted and reported on a parts per million (ppm) basis.
 (4) Format for data reported is Detected Concentration/Reported Detection Limit.
 (5) EPA 6010
 (6) BDL = Below Detection Limit

Note: Cadmium, Chromium, Lead, Mercury, Selenium, and Silver were conducted, but all results were reported as BDL.

TABLE 3
SUMMARY OF DETECTED ORGANIC COMPOUNDS
PIT WATER
BAILEY DISPOSAL SITE

PARAMETER	PIT A-3 (ppm)	Pit B (ppm)
VOLATILE COMPOUNDS ⁽¹⁾		
METHYLENE CHLORIDE	0.017/0.005 ^{(2)(3)*}	0.015/0.005*
ACETONE	BDL/0.010 ⁽⁴⁾	BDL/0.010
CARBON DISULFIDE	BDL/0.005	0.005/0.005 ⁽⁵⁾
1,2-DICHLOROETHANE	BDL/0.005	BDL/0.005
CARBON TETRACHLORIDE	BDL/0.005	BDL/0.005
TRICHLOROETHENE	BDL/0.005	BDL/0.005
BENZENE	BDL/0.005	BDL/0.005
TETRACHLOROETHENE	BDL/0.005	BDL/0.005
TOLUENE	BDL/0.005	BDL/0.005
CHLOROBENZENE	BDL/0.005	BDL/0.005
ETHYLBENZENE	BDL/0.005	BDL/0.005
STYRENE	BDL/0.005	BDL/0.005
XYLENES (TOTAL)	BDL/0.005	BDL/0.005
TOTAL PETROLEUM HYDROCARBONS ⁽⁶⁾	BDL/0.62	BDL/0.60

NOTES: (1) EPA Test Method 8240 (HSL)
 (2) Results of analysis converted and reported on a parts per million (ppm) basis.
 (3) Format for data reported is Detected Concentration/Reported Detection Limit.
 (4) BDL = Below Detection Limit
 (5) Identified compound present but below or at listed detection limit.
 (6) EPA Test Method 418.1

Note: * = Detected in laboratory blank.

determined to be adequate. Sampling procedures, such as labeling, packing, storage, and chain-of-custody procedures were inspected and determined to be in accordance with the Work Plan and QAPP, or as modified with approval of EPA's Project Manager.

Additionally, Mr. Neely reviewed the field data with the field supervisor regularly during the field work and prior to demobilization of equipment and crew to identify any data gaps and propose modifications to the scope as appropriate.

3.8 Summary of Field Investigation

The geotechnical borings indicate that soft to very soft soils underlie the site. At depths of 10 to 15 feet, the results of consolidation tests indicate that these soils are generally underconsolidated. This will be taken into consideration in design. The waste borings and trenches resulted in the compositing of waste samples into nine Sample Areas. Trenching was successful in Sample Areas 1, 2, 3, 5, and 7. This method would be a quick and economical way to determine the waste/soil interface prior to stabilization in these areas where the waste thickness is less than ten feet and groundwater infiltration is not severe. There was not enough difference in strength (penetration resistance) between the waste and natural soils for the CPT to accurately determine the waste/soil interface prior to stabilization. However, the CPT appears to be an attractive post-stabilization QA/QC method to evaluate the depth of stabilization and provide for the in-situ

determination of the unconfined compressive strength of the stabilized waste.

4.0 ADMIXTURE EVALUATION AND RESULTS

A literature review was performed and admixtures were selected based on the following criteria:

- Having a proven track record stabilizing waste similar to those at Bailey;
- Overall (site wide) potential for volumetric increase;
- Availability;
- Ease of application and versatility (wet or dry application);
- Compatibility with Application Techniques;
- Detrimental results (increasing leachability, volatilization, chemical composition and compatibility); and
- Cost.

The admixtures selected for laboratory evaluation were: Type I/II portland cement; lime kiln dust (LKD); fly ash; hydrated lime; and a 2 parts cement to 1 part fly ash combination.

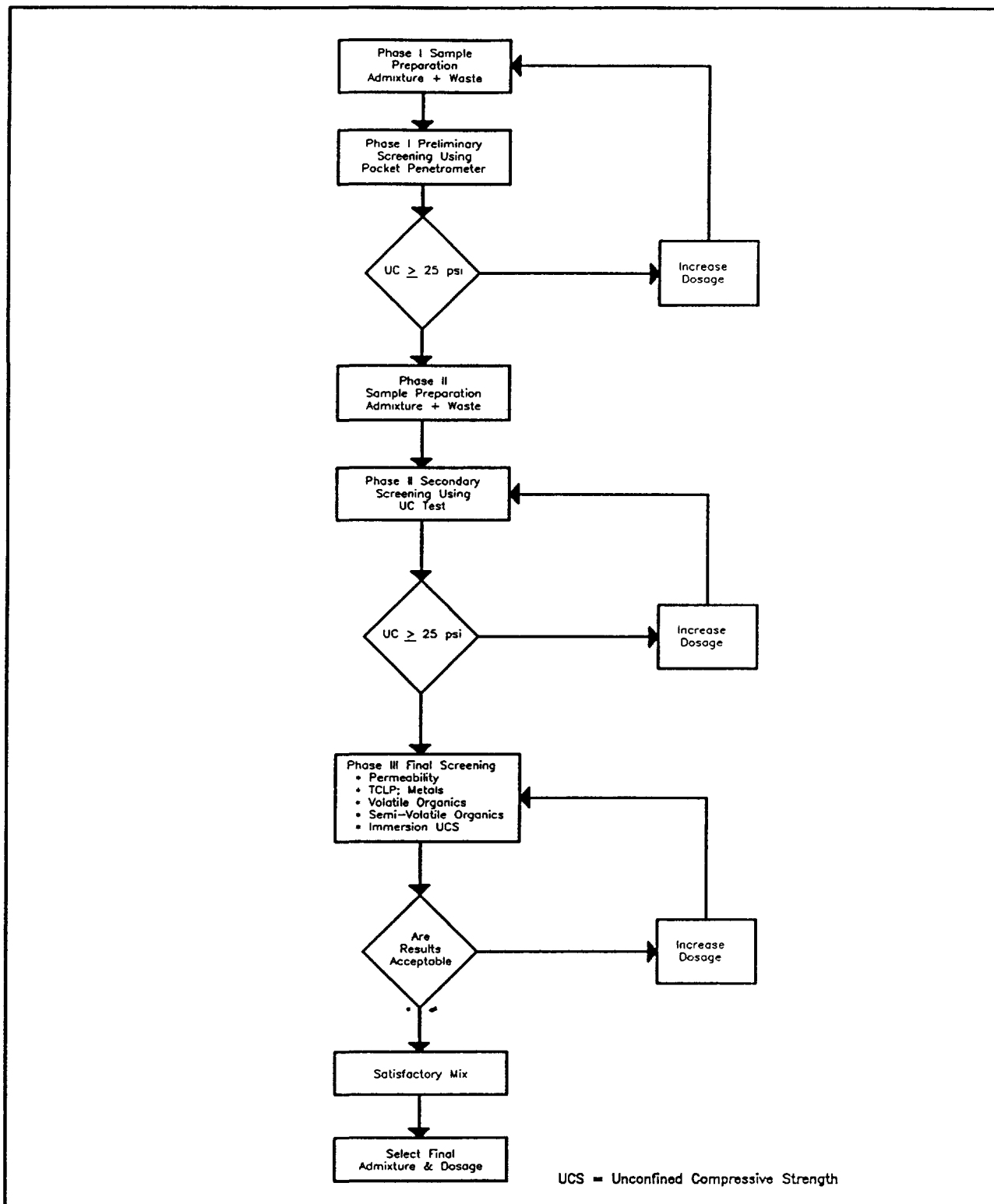
Cement kiln dust (CKD), Type V cement, organophylic clays and a variety of proprietary admixtures were also evaluated. Type V cement and CKD were not chosen because of excessive or incompatible cost, and/or lack of availability in the southeast Texas region. Proprietary admixtures and organophylic clays were evaluated for application where high oil and grease concentrations were indicated. The proprietary admixtures evaluated were extremely expensive, even when compared to high application rates (greater than 50%) of other admixtures. With regard to organic contaminant stabilization, studies have discounted some vendor

claims of stabilization. EPA studies indicate, inorganic contaminant stabilization with proprietary admixtures have proven to be not much better than with cement or pozzalanic admixtures. Organophylic clays typically have to be used with other admixtures (i.e. cement) to provide adequate strength and stabilization.

Nine composite samples representative of the waste encountered at the site were used in the admixture evaluation. Admixture screening was performed for specific admixture types and quantities that would result in a reduction of waste mobility and toxicity as required in the CD. These performance requirements were defined in the Work Plan as developing a minimum unconfined compressive strength of 25 psi and a permeability less than 10^{-6} cm/sec, or at least one order of magnitude less than the surrounding soils. Figure 4 presents the logic diagram from the Work Plan that overviews the three-phased approach that was used.

Phase I was a preliminary screening of the nine composite samples with three admixtures at three different dosages to evaluate their resulting compressive strength. A pocket penetrometer device was used for this determination.

Phase II secondary screening confirmed the unconfined compressive strength of the admixtures passing the Phase I screening. A modified ASTM Test Method D1633 was used to determine the unconfined compressive strength.



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Engineering and
Environmental Services

LOGIC DIAGRAM FOR STABILIZATION ADMIXTURES EVALUATION

FIGURE

4

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SDD

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APPROVED
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DATE
12/21/90

REVISED
RLW

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2/91

Phase III final screening of the admixtures passing Phase II screening evaluated the effects of stabilization on permeability, contaminant concentrations, mobility, and unconfined compressive strength after a 31-day immersion test.

4.1 Unstabilized Waste

Physical properties testing on the unstabilized waste materials was conducted to characterize the waste and to assist in evaluating the equipment and methods that could be used to move, store, and mix the waste materials during site remediation. In addition, these parameters were used to identify those wastes which have similar physical characteristics. This information, along with the analytical data, was used to evaluate if further compositing could be performed. It also assisted in choosing the initial dosages of admixtures to be used during the admixture evaluation testing.

Table 4 summarizes the results of the physical properties testing on the unstabilized waste and presents the associated test methods that were used. The parameters measured were moisture content, Atterberg limits, dry density, specific gravity, permeability, free liquids, and unconfined compressive strength.

The moisture content of the composite samples ranged from 27.1 to 169.3 percent. Two samples (Nos. 3 and 8), from the Drum Disposal and Pit Areas, respectively, had moisture contents above

TABLE 4
PHYSICAL PROPERTIES
UNSTABILIZED WASTE
BAILEY DISPOSAL SITE

PARAMETER	Sample Area 1 HLA COMP 10-T9	Sample Area 2 HLA COMP 14,15,16-T5,T6	Sample Area 3 HLA COMP 20-T8	Sample Area 4 HLA COMP 6,7,12- T1,T2,T3,T13	Sample Area 5 HLA COMP 8,9-T11,T12	Sample Area 6 HLA COMP 11,13-T10	Sample Area 7 HLA COMP 17,18,19- T7A,T7B	Sample Area 8 HLA COMP 1,2,3,4	Sample Area 9 HLA COMP 5
MOISTURE CONTENT (%) ⁽¹⁾	47.4	59.8	169.3	43.1	50.6	46.8	82.8	109.0	27.1
ATTERBERG LIMITS ⁽²⁾	NA ⁽⁸⁾	NA	NA	NA	NA	NA	NA	NA	NA
DRY DENSITY (pcf) ⁽³⁾	46.2	42.3	25.4	73.4	54.4	54.9	39.2	34.6	58.1
SPECIFIC GRAVITY ⁽⁴⁾	1.44 ⁽⁹⁾	1.44	1.44 ⁽⁹⁾	2.75	1.44 ⁽⁹⁾	1.44 ⁽⁹⁾	1.44 ⁽⁹⁾	1.65	1.07
PERMEABILITY (cm/sec) ⁽⁵⁾	9.6x10 ⁻⁷	7.6x10 ⁻⁷	2.3x10 ⁻⁷	2.3x10 ⁻⁸	4.5x10 ⁻⁸	2.4x10 ⁻⁷	8.2x10 ⁻⁷	2.3x10 ⁻⁷	2.8x10 ⁻⁸
PAINT FILTER (%) ⁽⁶⁾	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
UNCONFINED COMPRESSIVE STRENGTH (psi) ⁽⁷⁾	2.0	2.0	3.1	-0-	-0-	3.3	-0-	-0-	-0-

- NOTES: (1) ASTM Test Method D2216
 (2) ASTM Test Method D4318
 (3) ASTM Test Method D2937
 (4) ASTM Test Method D1429
 (5) EPA Test Method 9100
 (6) EPA Test Method 9095
 (7) ASTM Test Method D1633 with molding criteria as stated in Appendix C of the ISEWP, but with no curing.
 (8) NA = Material was either non-plastic, or did not exhibit soil like properties to allow testing
 (9) The specific gravity of Sample No. 2 (1.44) was used in calculating the permeability of these samples since their physical characteristics were similar.

100 percent. These two samples were tested a second time using the same ASTM test procedures except the oven temperature was reduced from 220°F to 186°F to reduce the potential for volatilizing organic constituents, which can lead to erroneous results. Because similar results were obtained at the lower oven temperature, it did not appear that the percent loss was due to volatilization and the high moisture content for Samples 3 and 8 are accurate.

The Atterberg limits tests could not be performed because the waste materials were either non-plastic, or were too sticky to determine a liquid limit.

The dry densities of the unstabilized waste ranged from 25.4 to 58.1 pounds per cubic feet (pcf), with an average of 47.6 pcf and a standard deviation of 13.5 pcf.

Specific gravity tests were conducted on four of the nine unstabilized waste samples for use in calculating the permeability test data. Sample No. 2 was considered to be representative of the black cindery/rubbery wastes (Sample Nos. 1, 2, 3, 5, 6, and 7). Sample Nos. 4, 8 and 9 were selected because of their distinct individual physical and chemical properties. The range of specific gravities was from 1.07 to 2.75, with an average of 1.73 and a standard deviation of 0.62.

The permeability of the unstabilized waste, as measured by the laboratory permeability tests, ranged from 2.3×10^{-6} to 2.8×10^{-8} cm/sec, with an average of 1.1×10^{-6} cm/sec and a standard deviation of 1.3×10^{-6} cm/sec.

and in the selection and determination of the admixtures and initial dosages for stabilization evaluation. The data were used to evaluate potential incompatibility when mixing wastes to be consolidated with in-place wastes; specific stabilization sectors with like characteristics; neutralization requirements; and chemical constituents in the waste (i.e. chlorides, sulfates, and oil and grease) that could adversely affect stabilization.

All of the unstabilized waste composite samples had a relatively neutral pH in the range from 6.1 to 8.3 as shown in Table 5. The pH was measured to provide information regarding potential neutralization requirements and to evaluate if any pretreatment was necessary to counter an acidic condition, which retards cementation. Pretreatment to counter an acidic condition did not appear necessary.

The chloride content of the waste (Table 5) ranged from 59.3 to 3920 ppm, with an average of 1657.3 ppm and a standard deviation of 953.8 ppm. Excessive chlorides values greater than 1500 ppm, can adversely effect unconfined compressive strength attainment, increase setting time, and increase leachability of metals with its resulting acidity. To reduce the leachability potential of metals due to high chloride concentrations, a low ammonia, sulfate-resistant cement, Type I/II Cement, was selected as the cement admixture for use in the admixture evaluation for the entire site.

TABLE 5
CHEMICAL CHARACTERIZATION
UNSTABILIZED WASTE
BAILEY DISPOSAL SITE

PARAMETER	SAMPLE AREA 1 HLA COMP 10-T9	SAMPLE AREA 2 HLA COMP 14,15,16-T5,T6	SAMPLE AREA 3 HLA COMP 20-T8	SAMPLE AREA 4 HLA COMP 6,7,12- T1,T2,T3,T13	SAMPLE AREA 5 HLA COMP 8,9-T11,T12	SAMPLE AREA 6 HLA COMP 11,13-T10	SAMPLE AREA 7 HLA COMP 17,18,19- T7A,T7B	SAMPLE AREA 8 HLA COMP 1,2,3,4	SAMPLE AREA 9 HLA COMP 5
pH ⁽¹⁾	8.34	6.85	6.22	7.52	6.55	6.84	6.50	6.10	6.62
CHLORIDES ⁽²⁾ (ppm) ⁽³⁾	593	628	1970	180	2504	1491	2920	1809	2821
SULFATES ⁽⁴⁾ (ppm)	194	593	475	830	1071	753	44	<48	505
TOTAL ORGANIC CARBON ⁽⁵⁾ (%)	90.67% ⁽⁶⁾	82.60%	35.70%	15.49%	92.67%	76.22%	75.80%	29.08%	31.40%
OIL AND GREASE ⁽⁷⁾ (%)	7.10%	6.71%	0.79%	1.53%	5.40%	2.83%	1.65%	27.66%	36.98%
TOTAL PETROLEUM HYDROCARBONS ⁽⁸⁾ (%)	1.84%	1.98%	0.32%	1.51%	4.61%	1.51%	0.54%	6.27%	50.65%

NOTES: (1) EPA Test Method 9045
 (2) EPA Test Method 9250
 (3) Data reported as mg/kg or parts per million (ppm)
 (4) EPA Test Methods 9035/9038
 (5) EPA Test Method 9060
 (6) Percent (%) x 10,000 = parts per million (ppm)
 (7) EPA Test Method 9070
 (8) EPA Test Method 418.1 modified for soils